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**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
- with (an) indication(s) in relation to deposited biological material furnished under Rule 13bis separately from the description

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: UDP-GLUCOSYLTRANSFERASES

(57) Abstract: This invention pertains to nucleic acid fragments encoding plant glucosyltransferases, heretofore undescribed, that exhibit catalytic activity with *p*-hydroxybenzoic acid (pHBA) as a substrate and only attach glucose to the aromatic carboxyl group of pHBA, to form the pHBA glucose ester. These enzymes have potential applications both *in vitro* and *in vivo*, and their primary amino acid sequences can be used to identify other proteins that have similar kinetic properties.



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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/05863

**A. CLASSIFICATION OF SUBJECT MATTER**IPC(7) : C12N 9/00, 9/10, 9/12; C07H 21/04  
US CL : 435/183, 193, 194; 536/23.2, 23.6

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 435/183, 193, 194; 536/23.2, 23.6

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
Please See Continuation Sheet**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, P	KOBAYASHI. S. et al. Myb-related genes of the Kyoho grape ( <i>V.labruscana</i> ) regulate anthocyanin biosynthesis. <i>Planta</i> , October 2002, Vol.215, pages 924-933.	1, 3, 4, 5,
A	ENDO. T. et al. Modification of limonoid metabolism in suspension cell culture of citrus. <i>Plant Biotechnology</i> (Tokyo, Japan), 2002, Vol. 19, No.5, pages 397-403.	1, 3, 4, 5
A	KITA. M. et al. Molecular cloning and characterization of a novel gene glucosyltransferase in citrus. <i>FEBS Letters</i> , 2000, Vol. 469(2,3), pages 173-178.	1, 3, 4, 5
A	McINTOSH. C.A. et al., Biosynthesis of naringin in Citrus paradasi:UDP-glucosyltransferase activity in grapefruit seedlings, <i>Phytochemistry</i> , 1999, Vol. 29, No.5, pages 1533-1538.	1, 3, 4, 5



Further documents are listed in the continuation of Box C.



See patent family annex.

Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

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Form PCT/ISA/210 (second sheet) (July 1998)

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/05863

### Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claim Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:  
Please See Continuation Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1, 3, 4, 5, SEQ ID NO:17 and 18

Remark on Protest

☐  
☐

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

PCT/US03/05863

### BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1, 3, 4, 5, drawn to polynucleotide encoding a Grape UDP-glycosyltransferase having an amino acid sequence SEQ ID NO:18.

Group II, claims 1,3,4,5, 6 drawn to polynucleotide encoding a Eucalyptus UDP-glycosyltransferase having an amino acid sequence SEQ ID NO:22.

Group III, claims 2, 4 drawn to a polynucleotide sequence encoding a Citrus mitis glycosyltransferase having an amino acid sequence SEQ ID NO:31.

Group IV, claims 7-10, drawn to a chimeric gene operably linked to suitable regulatory sequences and a host cell transformed with the chimeric gene.

Group V, claim 11, drawn to a method of increasing UDP-glucosyltransferase enzyme activity in a microorganism or green plant cell.

Group VI, claims 12-14, drawn to a method of increasing the ratio of the pHBA ester glucoside to total pHBA glucose conjugates in pHBA producing microorganisms and green plants.

Group VII, claim 15, drawn to a method of in vitro production of pHBA ester glucoside.

The inventions listed as Groups I-VII do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, ~~they lack the same or corresponding special technical features for the following reasons: Pursuant to 37 C.F.R. 1.475 (d), the~~ ISA/US considers that where multiple products and processes are claimed, the main invention shall consist of the first invention of the category first mentioned in the claims and the first recited invention of each of the other categories related thereto. Accordingly, the main invention (Group I) comprises the first-recited product, a polynucleotide encoding Grape glycosyltransferase and said polypeptide with SEQ ID NO:18. Further pursuant to 37 C.F.R. 1.475 (d), the ISA/US considers that any feature which the subsequently recited products and methods share with the main invention does not constitute a special technical feature within the meaning of PCT Rule 13.2 and that each of such products and methods accordingly defines a separate invention.

#### Continuation of B. FIELDS SEARCHED Item 3:

BIOSIS, CAPLUS, EMBASE, ESBIODASE, MEDLINE, AGRICOLA, SCISEARCH, DGENE, BIOTECHNO, USPTO WEST, GENBANK